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Geol Survey

STATE OF ILLINOIS
DWIGHT H. GREEN, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
FRANK G. THOMPSON, *Director*

DIVISION OF THE
STATE GEOLOGICAL SURVEY
M. M. LEIGHTON, *Chief*
URBANA

CIRCULAR NO. 121

The Illinois State Geological Survey In War Mineral Research

By M. M. LEIGHTON, *Chief*

FROM THE ANNUAL REPORT OF THE CHIEF TO THE DIRECTOR,
DEPARTMENT OF REGISTRATION AND EDUCATION,
FOR FISCAL YEAR 1944-45.



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URBANA, ILLINOIS

1945



The Natural Resources Building on the Campus of the University of Illinois houses the State Geological Survey and the State Natural History Survey Divisions of the Department of Registration and Education.

ILLINOIS STATE GEOLOGICAL SURVEY



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ANNUAL REPORT OF
THE GEOLOGICAL SURVEY DIVISION

to the Director, Department of Registration and Education
For Fiscal Year Ending June 30, 1945

By M. M. LEIGHTON, *Chief*



M. M. Leighton, Chief

The great mineral wealth of Illinois has been a significant factor in the important contribution which our State has been able to make to the nation's welfare and to its supremacy in production and manufacturing in World War II.

The State's production of mineral resources in 1943, which included coal, oil and gas, fluorspar, lead and zinc, glass sand, stone, clay, and other industrial minerals, placed Illinois fifth among all the states of the nation and first among the states of the rich Upper Mississippi Valley.

The kind and value of minerals produced in Illinois in 1944 was as follows:

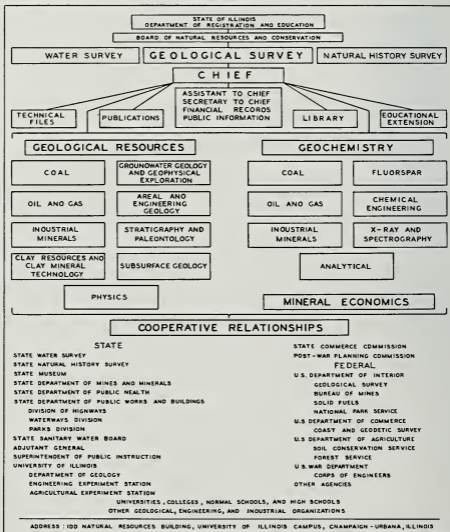
Coal	\$161,616,000	Lime	2,183,063
Oil and gas	113,055,890	Mineral wool	1,707,020
Clay and clay products	15,888,960	Other sand	1,446,165
Limestone and dolomite	10,681,866	Ground silica	1,076,785
Fluorspar	5,954,991	Tripoli	121,732
Cement	5,662,035	Other minerals	2,681,363
Silica sand	4,642,979		
Gravel	2,820,807	Total	\$829,589,066

Products of the mines of Illinois constituted 53.2 percent of the revenue freight originating in the State in 1944. The remaining 46.8 percent consisted of: Manufacturers and miscellaneous, 32.5 percent; agricultural products, 10.9 percent; animals and animal products, 2.8 percent; and forest products 0.6 percent.

The Geological Survey Division of the State Department of Registration and Education, since its establishment in 1905, has been exploring in the field and laboratory the mineral resources of Illinois, conducting intensive fundamental research upon them with a view to increasing their usefulness and production, and has been providing accurate scientific information on them to owners, producers, manufacturers, consumers, and interested citizens.

Its scientific and technical staff includes geologists, chemists, physicists, engineers, a mineral economist, and college trained assistants, and it is organized to function as a well coordinated unit. The following chart shows diagrammatically the arrangement and integration of the various sections and divisions and the cooperative relations with other state and federal agencies.

It carries on its work in the specially equipped Natural Resources Building and an applied research laboratory, both located on the University of Illinois campus. These buildings with their twenty-nine laboratories possess the most modern of equipment for research including such special facilities as a micro-analytical laboratory, X-ray and spectrographic equipment, a specially designed coke-oven, coal preparation equipment, combustion stokers fully instrumentated, a briquetting machine, and many other pieces of standard and special apparatus for the study of the non-metallic minerals. The Survey also possesses an experimental geophysical truck.



Organization chart.

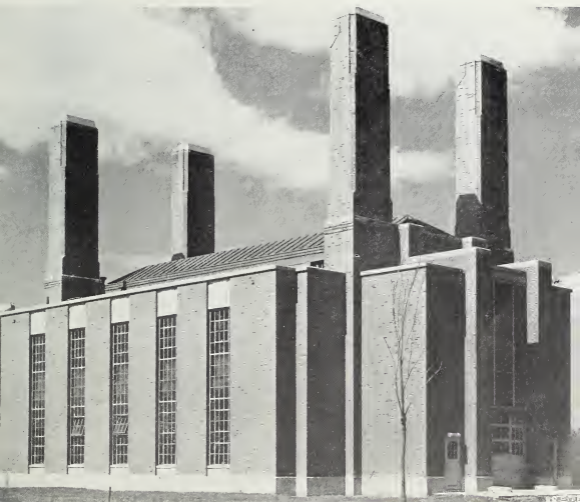
The Geological Survey's Applied Research Laboratory where semi-plant scale experiments work toward improved products from Illinois mineral resources.

Activities and Accomplishments During the Fiscal Year 1944-1945

Since the United States' entry into the war in December, 1941, the research program of the Illinois Geological Survey has centered around projects related to the war effort. Some of these have been carried on under formal contract with Federal war agencies, others have been undertaken at the request of the Federal Government, still others are independent of cooperative effort, yet all have the same objective—fundamental information of lasting value to the economy of the State and Nation, both now in time of war and in the time of peace to come.

Coal

Under the stimulus of war activities the output of bituminous coal in Illinois in 1944 rose to 76,960,000 tons. This output to meet wartime demands required an unusually large production of coal dur-



ing the summer, which is normally a period of low activity in Illinois with many mines shut down. Illinois coal not only claimed part of the market in the Middle West usually supplied by West Virginia but coal was shipped to destinations hitherto not supplied by Illinois.

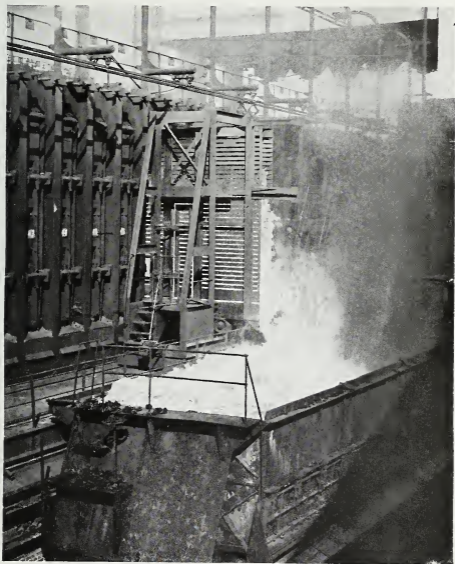


Pulling a charge of coke from the Survey's experimental oven.

1. An investigation of the use of Illinois coals in the manufacture of metallurgical coke, initiated as Contract WPB-75 in August, 1943, has been continued through June 30, 1944. The immediate war objective of this project has been to save transportation by the

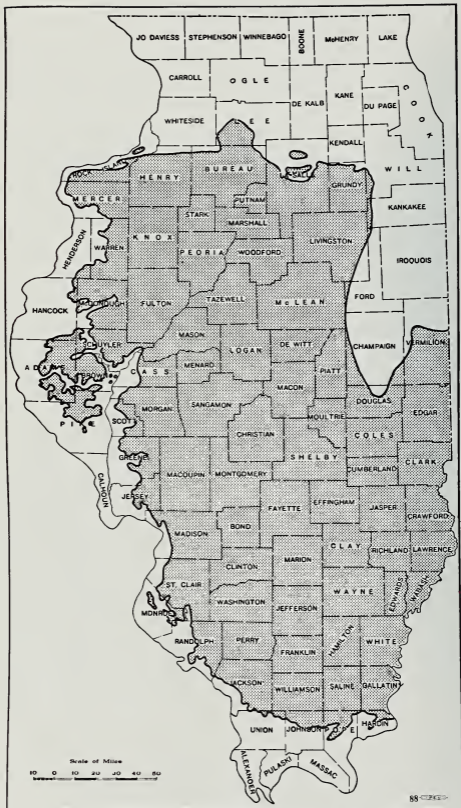
partial substitution of suitable Illinois coals for eastern coals for use in metallurgical coke ovens in the Chicago and St. Louis areas.

An experimental slot-type coke oven of 500-pound coal capacity, designed and constructed by the Survey staff and operated in the



A battery of commercial coke ovens at a Southern Illinois plant.

Survey's applied research laboratory, was used to obtain unusually reliable information on the coking properties of blends of low-sulphur high-volatile Illinois coals with eastern high- and low-volatile coking coals. Their by-products were recovered and analyzed in the Sur-



More than half of Illinois is underlain by the Coal Measures.

vey's chemical laboratories. The coke produced is almost identical to that produced from the same coal in commercial plants. Two large coke plants, one in the Chicago area and one in the St. Louis area, became interested in this work and arranged to have tests made in their plants to check the laboratory results.

During 1944, as a result of this work, one of these plants used about 141,300 tons of Illinois coal mined within 80 miles of the plant. This replaced West Virginia coals and made possible a transportation saving of approximately 1,442,000 car miles. In the other plant, experimental studies will be continued.

2. Studies directed toward the development of improved stoker fuels have been carried forward by a series of combustion tests on some 43 Illinois coals produced in 15 different localities and representing all commercially important Illinois mining districts and coal beds. The coals are burned in a regular domestic stoker and their combustion characteristics are carefully recorded and compared with other characteristics revealed by chemical and physical analyses, etc. This testing program has proved of interest to many individuals and organizations, and it is hoped that from it information will be gained which will lead to better stoker fuels for both commercial and domestic use.

3. Refinements of design and materials in the Survey's briquetting press, achieved during the past year after many delays resulting from wartime conditions, have brought this work to the point where industry can evaluate the possibilities of briquetting Illinois coal fines without the use of binder, at elevated temperature and pressure.

4. Mapping of the resources of commercially important coal beds of the State was carried forward in seventeen different counties during the year. A structure map that includes parts of Montgomery, Shelby, Christian, and Sangamon counties was completed and published.

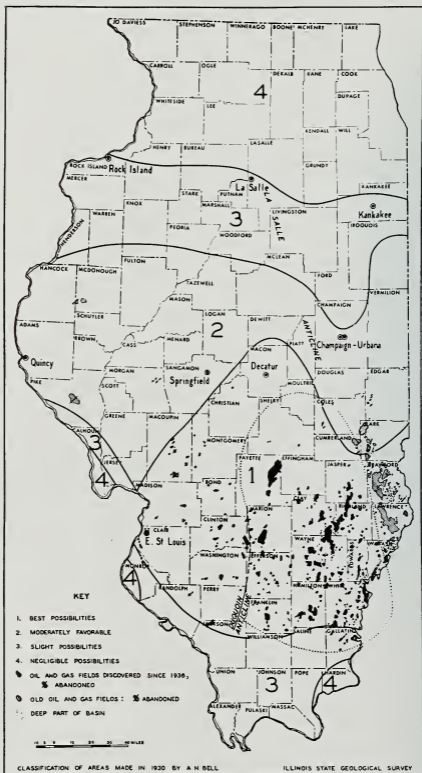
This work not only adds to the Survey's already large inventory of information on Illinois coals, but provides data of great value for exploring structures potentially favorable for the accumulation of oil and gas.

5. Much information has been provided to coal operators and engineers and valuable assistance has been given them in evaluating areas for opening up mines and in interpreting the results of diamond-drill testing.

6. Microscopic study of fossil plant spores contained in coal has led to the valuable discovery that the identification of these minute organic particles can aid in the correlation of the various beds of coal.

Oil and Gas

The discovery in 1937 of oil in the area known as the Illinois basin came as a result of the combined efforts of the oil industry and the State Geological Survey, and at a time which has proved to be of critical value to the nation. Although Illinois production has de-



MAP CLASSIFYING OIL AND GAS POSSIBILITIES IN ILLINOIS
 SHOWING PRODUCING AREAS AS OF JANUARY 1, 1945

clined since the peak reached in 1940, the rate of normal decline due to the passing of flush production has been checked by the discovery of many new small pools and new pay sands, by the extension of old fields, and by the application of secondary recovery methods. Illinois holds sixth place among the oil producing states of the country. From July 1, 1944 to July 1, 1945, Illinois produced approximately 75,230,000 barrels of crude oil valued at roughly \$102,000,000. The industry discovered 31 new oil fields and 49 extensions to pools.

7. The collection, examination, and correlation of a large number of drilling records have continued to form the basis for the preparation of maps and reports which serve as guides in the location of new oil pools and the extension of old pools.

8. A special investigation was made of the occurrence of oil in a Silurian coral reef structure in the Marine pool of Madison County, and a report is being prepared with a view to aiding in the location of similar coral reefs elsewhere in the Illinois basin.

9. A new revised edition of the State Oil and Gas map has been completed and is in the hands of the engravers.



Natural gas plant at Lake Centralia, Illinois.

10. Publication has been continued of monthly drilling reports that summarize in clearly tabulated form the drilling and production activities throughout the State.



Corner of rig floor of a drilling oil well in Illinois.

11. Partly as a result of the Survey's study of water-flooding methods for the secondary recovery of oil, this process is now being used successfully in several areas in the State. In one of these 1,200 barrels per day are being obtained. Detailed studies of oil field

reservoir rocks are also contributing data which will be of value in prospecting for new producing areas and for evaluating the reserves of known areas.

12. An annual report on Oil and Gas Developments in Illinois in 1944 has been published. Revision has been completed on development maps of 34 areas, each 3 townships square.

Fluorspar

The mineral fluorspar has been of extreme importance during the war because it is used in the making of steel, in the production of aluminum, and in the manufacture of hydrofluoric acid which is used in turn as a catalyst in the making of high-octane gas and as raw material in the manufacture of important fluorine chemicals. The deposits of fluorspar which occur in the Illinois-Kentucky area produce about 80 percent of the national output and constitute the largest deposit of this strategic mineral in the western hemisphere.

13. At the request of the War Production Board, the Survey has been cooperating with the U. S. Geological Survey and the U. S. Bureau of Mines in the search for additional ore in southern Illinois by the preparation of large-scale detailed geologic maps of local areas, by careful study of the mode of occurrence of the ore, and by the suggestion of favorable areas for exploration.

14. Laboratory investigation on the synthesis and properties of aromatic fluorine compounds with a view to their possible industrial applications has been carried forward. During the past year the Illinois Geological Survey was able to furnish to the Federal Government a sample of one of these organic chemicals which could not be obtained from any other source.

Zinc and Lead

The lead and zinc resources of our country have been reduced to a point of considerable concern to our national economy and the increased demand for these metals brought about by the war has made the search for additional supplies imperative. In April of 1943 the Survey undertook intensive geologic investigations of the old producing area in northwestern Illinois, working in close cooperation with the U. S. Bureau of Mines.

15. An office has been established in Galena and is staffed during the field season by four Survey men. During the past year four reports have been prepared for war agencies and the Survey's work has aided in exploration which led to the discovery of an ore body carrying 1,800,000 tons of about 5 percent zinc ore and another of approximately 100,000 tons. Both lead and zinc are now again being commercially produced in this area.

Clays

16 An investigation bearing on the extraction of aluminum from clays, carried on under WPB contract, was completed in the fall of 1944. Permission has been granted the Survey to publish a report on this research, which will provide specific information of fundamental value to the extraction of alumina from clay by the alkaline process.

17. Continuing research on the composition and properties of all types of Illinois clays and shales is in progress to determine their suitability for varied and specific industrial uses, both in the ceramic and in the nonceramic fields. A report on Illinois clays and shales as mortar mix has been issued and another on the possible use of Illinois surface clays in rebonding molding sands is ready for press.

18. A special investigation, carried on cooperatively with the Department of Mechanical Engineering of the University of Illinois under the sponsorship of a large clay products company, on bonding clay properties has been completed during the past year and reports have just been published. The interested reader is referred to this report for important details.



Mining fireclay at Goose Lake, Illinois.

Rock and Rock Products

Illinois possesses extensive deposits of rock materials such as limestone, dolomite, silica and silica sand, gravel, etc. which play a less striking but nevertheless effective and important role in our industrial economy.



Huge quarries occur in the State that yield large tonnages and convert stone resources into wealth.

19. Limestone has many special uses and it has been one of the Survey's long-range projects to assemble scientific data on the occurrence, composition, and character of the State's vast deposits. The Survey's fund of information is frequently drawn upon by both producers and construction companies. The Survey also advises regarding possible quarry sites for agricultural limestone and tests samples for land owners, etc. In 1944 Illinois produced 4,214,600 tons of "agstone" and it appears certain that after the war the demand will be even greater.

20. During the past year, many requests have been received from all over the United States and one from Australia for the Survey's publication on rock wool (published in 1934.) These have come from technical men of well established companies and indicate



A large glass sand quarry in Illinois.

a continued interest in mineral insulation and the source rocks for its production.

21. Studies made of the abrasive qualities of various grades of ground silica have resulted in the assembling of considerable data on the fundamental properties both of the "hard" silica of northern Illinois (produced by pulverizing silica sand) and of the "amorphous" or "soft" silica of southern Illinois. The information so acquired will provide a basis for extending the field of usefulness of these materials.

22. The Survey's assistance was given to a large producer of silica sand in finding that the tailings from the sand washers could be used as a source of fine-grained molding sand required in the production of certain specified types of castings. In another case of the Survey's cooperation, a large sand and gravel corporation was advised as to sand deposits that would meet particular specifications and open a new industry.

23. Special reports on mineral resources have been prepared for the industrial agents of several railroads interested in the location of industries along their right-of-ways.



Modern hydraulic mining of silica sand in an Illinois quarry.

Groundwater Resources

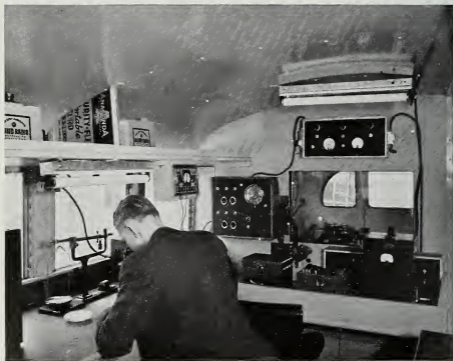
The problem of adequate water supply has received a great deal of attention in recent years. The erection of army camps and ordnance plants and the establishment of large war industries have greatly increased the demands for this essential resource and have served to intensify the interest in it. To help meet these needs, the Geological Survey cooperates with the Water Survey where geological problems or information are involved.

24. During the past year the Geological Survey's geologists have cooperated with the State Water Survey and have prepared 172 special reports on the geology of groundwater possibilities at specific locations.

25. Electrical earth-resistivity surveys to locate deposits of water-bearing sand and gravel were made for eleven towns and industrial plants, and other similar surveys are in progress. The Survey is scheduled many months ahead for this service.



The State Survey's Geophysical laboratory.



Interior of the Survey's Geophysical field laboratory.

26. Geophysical surveys of wells in which methods commonly used in oil well engineering have been applied to water wells, have been run on 19 large industrial or municipal wells. Rehabilitation measures taken upon recommendations based on these electrical surveys have resulted in most cases in substantial increases of yield. These surveys are usually made under contract with commercial logging companies with Geological Survey representatives observing, running certain special logs where desirable, interpreting the data, and recommending remedial measures. The field equipment needed for this work has been installed in a large truck which constitutes a very efficient mobile laboratory unit. (See illustration.)

27. Assistance is given, in cooperation with the State Water Survey, to water well drillers in the acidizing of wells to improve the yield.

Engineering Geology

Geological information is fundamental to many engineering problems concerned with highway construction, selection of reservoir sites, building of dams, stability of foundations, drainage, etc. The Survey assists other state and federal agencies in problems of this type, exercising every care not to infringe on the field of private consulting practice. A few outstanding examples of the service rendered are cited here.

28. During the year requests were received and reports are in progress relating to geological conditions at 30 damsites for the U. S. District Engineers Office in Chicago.

29. Information was furnished to the Chief of Engineers of the U. S. Department of War on the geology of various areas in the State in connection with seismic tests at proposed damsites.

30. Examination was made of test borings at various proposed damsites for the State Waterways Division.

31. An electrical resistivity survey was run to outline a deposit of sand and gravel for use as subgrade replacement material for the State Highways Division.

32. A report was prepared on the geologic conditions relating to subsurface drainage and foundation stability at the proposed site of a fertilizer plant to be erected by the Illinois Agricultural Association.

Mineral Economics

The economic trends in mineral production, transportation, and marketing are critical factors in industrial development, and through the employment of a mineral economist with a small staff of assistants to follow and analyze these trends the Survey is in a position to furnish economic information desired by mineral operators, producers, and manufacturers throughout the State.

33. An annual statistical report is prepared on the mineral production and industry of the State. Cooperation is given by the State Department of Mines and Minerals, by the U. S. Bureau of Mines, and by the U. S. Bureau of Census.

Topographic Mapping

In cooperation with the U. S. Geological Survey a systematic program of topographic mapping is carried forward in the State each year.

34. During the year covered by this report 784 square miles of territory, including 112 square miles of revision, were mapped topographically on a scale of one inch to the mile.

Publications

Prompt publication of results obtained from research work is essential to its greatest effectiveness. Every effort is made to furnish information to Illinois citizens as soon as possible, consistent with accuracy.

35. During the year one new Bulletin, 7 Reports of Investigations, 2 Illinois Petroleums, 14 Circulars, and 12 monthly Drilling Reports have been issued.

36. In addition to published reports, the Survey functions as a public information bureau on matters relating to mineral resources, their occurrence, distribution, and development. Through conferences and correspondence the Survey stands ready to assist in the development and conservation of these natural resources.

37. Assistance is given to the schools throughout the State by furnishing maps and bulletins for their use in the classroom or reference library as well as by many letters giving information on the geology of their immediate environs for educational use. Sets of rock and mineral specimens with printed labels and study manuals are furnished as a part of the Survey's educational extension program, and during the year 70 such collections have been placed in Illinois schools.

The function of the Geological Survey as an agency through which the people of Illinois can avail themselves of accurate scientific information is of vital importance to the welfare and advancement of the State, and it is to this end that the Survey's research is devoted.

The Board of Natural Resources and Conservation

The Geological Survey, the Natural History Survey, and the Water Survey are under the direction and control of The State Board of Natural Resources and Conservation. This board, created by the Civil Administrative Code in 1917, is composed of distinguished scientists, each qualified by at least ten years professional experience in their several fields, and functions under the ex officio chairmanship of the Director of the State Department of Registration and Education. The personnel of the Board is as follows:

Chairman—Honorable Frank G. Thompson

Ex Officio Member—Dr. A. C. Willard, President of the University of Illinois

Forestry—Professor Ezra J. Kraus, University of Chicago, Vice-President and Secretary of the Board

Geology—Professor Norman L. Bowen, University of Chicago

Chemistry—Professor Roger Adams, University of Illinois

Engineering—Louis R. Howson, Chicago

Biology—Professor Carl G. Hartman, University of Illinois

Under the law this Board selects and appoints, without reference to the State Civil Service law, all members of the technical staffs of the three scientific surveys. Traditionally nonpartisan, its members serve without pay. Membership is by appointment of the Governor, and it is a standing tribute to the broad vision of our State administration and to the abilities of the Board members that since the Board's inception, changes on the Board have been made only by the death or retirement of a member. Because several sciences, two different universities, and industry are represented by the Board membership, its points of view are broad and in the interest of the people of the entire state.

The Board, which meets at regular intervals, receives and carefully studies quarterly reports from the three chiefs of the Scientific Surveys. Members of the Board frequently make field inspections of projects with which they are most intimately concerned.

By their wise guidance of the individual Surveys and their coordination of the activities of these three organizations, members of the Board have through the years made valuable contributions to the development, intelligent utilization and conservation of the state's natural resources. Their devotion to the responsibilities imposed upon them by law, their recognition of measures consistent with sound public policy, their comprehension of fruitful research programs, and their exercise of infinite care in selection of scientific staffs have brought national and international recognition of Illinois and its wealth of natural resources.

Although the three Scientific Surveys are administered by the State Department of Registration and Education, location of the Surveys' headquarters and principal laboratories on the University of Illinois campus at Urbana offers many advantages. Research is furthered through the availability of the University libraries and some of the laboratories and experimental field-plots, and in like manner Survey facilities are made available to University staff members and some advanced students seeking professional training. Cordial relations and a generous exchange of information between University and Survey staffs make for prompt and effective dissemination of the results of research. Operational economy is also achieved by one system, maintained by the University, that provides water, heat, light and other services for the Surveys and the University.



Architect's sketch of proposed wings to the Natural Resources Building.

Headquarters, Offices and Laboratories

Because much of the work of the Water Survey is intimately associated with chemistry, headquarters and main laboratories of that organization are located in the William Albert Noyes Laboratory of Chemistry.

Until 1940, the Geological Survey had most of its offices and laboratories in the Ceramics Building, the Geological Survey Annex and other quarters, and the Natural History Survey, while maintaining headquarters in the Natural History Building, had many of its offices and laboratories in other buildings scattered over the campus. The need for modern scientific laboratories and centralization of staff personnel led to an appropriation of \$300,000.00 by the Assembly of the State of Illinois in 1937, grants from the Federal Government of \$245,454.00 and \$22,000.00, respectively, and then in 1939 an additional appropriation from the State of \$200,000.00 for equipment.

By July, 1940, the first unit of the Natural Resources Building was nearing completion, and members of the Geological and Natural History Survey staffs were moving into their new offices and laboratories. The Natural Resources Building in its present form comprises this first unit, which was so planned that new units might be added conveniently and economically as expanding programs and staffs made necessary an increase of floor space.

Although the exterior of the building conforms to the stately Georgian design of other campus buildings, utility rather than beauty was the guiding principle in designing, constructing, and equipping the interior. However, the foyer illustrates the decorative possibilities of certain Illinois building materials, and many of the laboratories exemplify the functional beauty concept of modern design.

To provide for the greatly increased needs of the Geological and Natural History Surveys growing out of natural expansion in the varied aspects of fundamental and applied research related to our vital natural resources, a post-war project approved by the Illinois State Post-War Planning Commission and made possible through legislative appropriation provides for the construction of wings to the Natural Resources Building. The final structure as planned and shown in the accompanying State Architect's sketch, will constitute one of the finest and most complete units for research on natural resources in the country.

